Title: Scooter Race

Brief Overview:

Students will choose a design and construct a racetrack for scooters. They will need to construct (according to specific attributes given) and compute the perimeter and area of each design (rectangle, triangle, circle). They will also need to determine the cost of building the track (asphalt, turf, concrete) and fencing (wood, vinyl, aluminum). Students will then choose the best design based on a variety of factors including cost, safety, and spatial sense related to purpose, and support their choice using mathematical reasoning. Additionally, students will compute other costs and choose scooters and safety helmets. Finally, students will need to compute the total cost and write to inform the PTA of their detailed proposal for a scooter racetrack.

NCTM 2000 Principles for School Mathematics:

Equity: *Excellence in mathematics education requires equity - high expectations and strong support for all students.*

Curriculum: *A curriculum is more than a collection of activities: it must be coherent, focused on important mathematics, and well articulated across the grades.*

Teaching: *Effective mathematics teaching requires understanding what students know and need to learn and then challenging and supporting them to learn it well.*

Learning: *Students must learn mathematics with understanding, actively building new knowledge from experience and prior knowledge.*

Assessment: *Assessment should support the learning of important mathematics and furnish useful information to both teachers and students.*

Technology: *Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning.*

Links to NCTM 2000 Standards:

Content Standards

<u>Number and Operations</u>

Understand meaning of operations and how they relate to one another; understand various meanings of multiplication and division; and understand the effects of multiplying and dividing whole numbers.

Compute fluently and make reasonable estimates; develop and use strategies to estimate computations involving fractions and decimals in situations relevant to students' experience; and select appropriate methods and tools for computing with whole numbers from among

mental computation, estimate, calculators, and paper and pencil according to the context and nature of the computation and use the selected method or tools.

Algebra

Use mathematical models to represent and understand quantitative relationships; and model problem situations with objects and use presentations such as graphs, tables, and equations to draw conclusions.

Analyze change in various contexts; investigate how a change in one variable relates to a change in a second variable; and identify and describe situations with constant or varying rate of change and compare them.

Geometry

Analyze characteristics and properties of two-and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships; identify, compare, and analyze attributes of two- and three-dimensional shapes and develop vocabulary to describe the attributes; explore congruence and similarity;

Use visualizations, spatial reasoning, and geometric modeling to solve problems; build and draw geometric objects; create and describe mental images of objects, patterns, and paths; identify and build a three-dimensional object from two-dimensional presentations of that object; identify an draw a two-dimensional representation of a three-dimensional objects; use geometric models to solve problems in other areas of mathematics, such as number and measurement; and recognize geometric ideas and relationships and apply them to other disciplines and to problems that arise in the classroom or in everyday life.

Measurement

Understand measurable attributes of objects and the units, systems, and processes of measurement; understand such attributes as length, area, weight, volume, and size of angle and select the appropriate type of unit for measuring each attribute; understand the need for measuring with standard units and become familiar with standard units in the metric system; and explore what happens to measurements of a two-dimensional shape such as its perimeter and area when the shape is changed in some way.

Apply appropriate techniques, tools, and formulas to determine measurements, develop strategies for estimating the perimeters and areas of shapes; select and apply appropriate metric units and tools to measure length, area; and select and use benchmarks to estimate measurements.

Process Standards

Problem Solving

Instructional programs from pre-kindergarten through grade 12 should enable all students to build new mathematical knowledge through problem solving; solve problems that arise in mathematics and in other contexts; apply and adapt a variety of appropriate strategies to solve problems; and monitor and reflect on the process of mathematical problem solving.

Reasoning and Proof

Instructional programs from pre-kindergarten through grade 12 should enable all students to recognize reasoning and proof as fundamental aspects of mathematics; make and investigate mathematical conjectures; develop and evaluate mathematical arguments and proofs; and select and use various types of reasoning and methods of proof.

Communication

Instructional programs from pre-kindergarten through grade 12 should enable all students to organize and consolidate their mathematical thinking through communication; communicate their mathematical thinking coherently and clearly to peers, teachers, and others; analyze and evaluate the mathematical thinking and strategies of others; and the language of mathematics to express mathematical ideas precisely.

Connections

Instructional programs from pre-kindergarten through grade 12 should enable all students to recognize and use connections among mathematical ideas; understand how mathematical ideas interconnect and build on one another to produce a coherent whole; and recognize and apply mathematics in context outside of mathematics.

Representation

Instructional programs from pre-kindergarten through grade 12 should enable all students to create and use representations to organize, record, and communicate mathematical ideas; select, apply, and translate among mathematical representations to solve problems; and use representations to model and interpret physical, social, and mathematical phenomena.

Grade/Level:

Grades 4 - 5

Duration/Length:

Total time for this assessment is 3 days, approximately 60 minutes per day.

Prerequisite Knowledge:

Students should have working knowledge of the following skills:
Computing cost when given specific prices, amount of units, and area or perimeter.
Attributes of a circle, rectangle, and scalene triangle.
Using a ruler (metric), compass, and Explorer calculator.
Methods to determine the area and perimeter of a rectangle, triangle, and a circle (circumference).
Writing to inform, including mathematical support.
Experience using the Quick Write technique

Student Outcomes:

Students will be able to:

List the factors to consider in designing and building a scooter racetrack.
Construct geometric shapes according to the given attributes. (circle, triangle, rectangle)
Compute the area and perimeter of the above named shapes.
Make decisions and choices based on mathematical reasoning.
Calculate the costs of materials and equipment involved in building and running a scooter race.
Write a proposal to inform the PTA of their decisions and the final cost.

Materials/Resources/Printed Materials:

Compass
Ruler
Pencil
Meter sticks
Explorer calculators
Overhead and transparencies or chart paper
Student Activity Booklet (Vignette and all work pages)
Masking Tape
Centimeter grid paper
String

Development/Procedures:

<u>Day 1</u>

Materials

One copy for each student of the activity booklet
Compass
Ruler
Pencil
Overhead and transparencies or chart paper
Centimeter grid paper
Masking tape
Meter sticks
String

Introduction

Orally survey students regarding interest in participating in a scooter race.
Hand out student activity booklets. Review and discuss the vignette on page one of the booklet.

Activity 1

Randomly place the students into three cooperative groups. Students will make racetracks in a variety of shapes. Each group will be assigned a geometric shape to construct (rectangle, triangle, circle) with given measurements. (You may wish to vary the size of each shape depending on space available. Keep in mind the shape needs to be large enough for the students to simulate a scooter race. (See Teacher Resource Sheet # 1 for suggested dimensions and directions on constructing the shapes.)

Guide each cooperative group in constructing the given shape on the floor using masking tape, a meter stick, and the given measurements. (The string is to complete the circle. See Teacher Resource Sheet # 1.)

Each completed shape will serve as a station. Groups will rotate stations in three-minute intervals. At each station, the group members will have a chance to participate in a simulated "scooter race." Students will "race" on another by walking the perimeter of the track in pairs. Then switch (inside/outside) positions and repeat so all group members experience "racing" that shape. (Encourage students to note details such as, difficulty of turns, speed, space, and distance of each shape.)

After completing all three of the stations redirect students back to small groups. Have students Think/Pair/Write/Share the details they noted. (Student Activity Booklet page 2)

Lead a group discussion to share student reactions and comments about the three "tracks". Record their ideas on the overhead or chart paper.

Activity 2

Instruct students to open their booklet to page 3 and read the specifications for constructing each shape.

Review scoring tools on activity booklet pages 5-7 with students before constructing shapes so they are clear concerning what is expected of them.

Students will work independently to construct and label the three figures on their centimeter grid paper (student activity booklet page 4) according to the specifications given.

Students use activity booklet pages 5-7 to evaluate their work and that of a partner.

Using his/her designs, instruct each student to determine the best one for a scooter racetrack and write a short answer to support their choice on activity booklet page 8.

Assessment

Use student activity booklet pages 5-7 to assess completed geometric constructions.

Evaluate short answer responses using the scoring rubric on Teacher Resource page 2.

<u>Day 2</u>

Materials

Student booklets

Explorer Calculators

Overhead

Introduction

Review details list on overhead (students contribute ideas from their activity booklet, p.2 and volunteer to lists then them on overhead), then focus on what is needed to determine the cost of building a racetrack for the scooter race.

Explain to students that today they will have to choose materials for the surface of the track as well as the fencing around the track.

Guide students to suggest that perimeter will be needed to compute the cost of the fence and area will be needed to compute the cost of the surface of the track. Elicit from students the concepts of perimeter and area as they relate to the cost of the materials needed.

Activity 1

Instruct students to open their activity booklet to page 9 and compute the perimeter and area of each of the shapes that they constructed the previous day.

Students determine the cost of each surface and fencing material. (Student activity booklet pages 10 and 11). Students may use calculators to find the answers.

Discuss the pros and cons of each of the materials that could possibly be used to construct the racetrack using Think/Pair/Share (whole group).

Students use problem solving and decision-making skills to choose the surface and fencing material. (See student activity booklet page 12) Students will write a short answer to explain their choice of materials. Encourage students to support their ideas with mathematical concepts.

Assessment

Evaluate area and perimeter computations by scoring student activity booklet page 9, one point for each correct response and 0 for an incorrect response.

Use short answer rubric on Teacher Resource Sheet # 2 to evaluate response regarding materials.

<u>Day 3</u>

Materials

Student Packet
Pencils
Explorer Calculator
Overhead

Introduction

Instruct students to share their responses from yesterday with their small group.

Brainstorm, using a roundtable format, equipment that would be needed for the race.

Allow a student to record ideas, in list form, on the overhead or chart paper.

Activity 1

Explain to students that today they are going to make decisions about purchasing two pieces of necessary equipment: scooters and helmets.

Lead a brief discussion regarding the number of racers who will participate in each race to determine how many pieces of equipment must be purchased.

Review directions on student activity booklet page 13 regarding the types of scooters and helmets available.

Instruct students to calculate the costs and make their decisions independently (working in booklet).

Activity 2

Revisit the vignette. Discuss topic, purpose for writing, intended audience, and form with the students. Elicit any questions students may have regarding the writing prompt.

Review the attached rubric and remind students to use it as a reference while writing the proposal.

Explain that this will be done in a quick write fashion (20 minutes to write). Remind students that they will have approximately 5 minutes to proofread and edit their writing after the initial prompt is complete.

Upon completion of the writing prompt, collect student activity booklets.

Assessment

Evaluate computational work on student activity booklet page 13 for accuracy. Score on a scale from 0 to 5.

Score writing prompt using Teacher Resource Sheet # 3.

Teacher Resource Sheet # 4 is an optional overall scoring tool.

Extension/Follow Up:

Instruct students to:

Use centimeter graph paper to construct similar and congruent figures to those constructed in class.

Construct a model of their scooter racetrack to display when they present their proposal.

Make a scale drawing of their completed racetrack.

Design a new task to include a concession stand at the track.

Write a formula, using variables, for finding the cost of the surface as well as fencing materials.

Choose a new geometric shape and figure the cost, area, perimeter, etc.

Research racetracks to find common characteristics and share your findings with the class.

Authors:

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Scooter Race

Student Activity Booklet

Name _____

Date _____

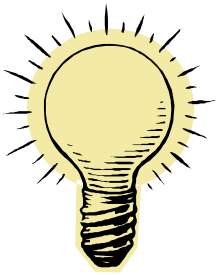
Student Activity Booklet Page 1

Vignette

During the Spring Fair your school is going to host a Scooter Race to help raise money for the fifth grade promotional activities. The PTA is willing to sponsor the scooter race, but they need your assistance in planning the event. Put on your **thinking cap** because you will be making decisions about building materials as well as equipment that will need to be purchased. Begin by choosing an appropriate design for the racetrack. Next, you will construct the track and find the cost of the materials and equipment. You even get to choose the type of scooters and helmets that will be purchased! Finally, you will write a proposal, which will be presented to the PTA.

Student Activity Booklet Page 2

Think



Pair

Write

_____

_____

_____

_____

_____

_____

Share

Student Activity Booklet Page 3

Introduction

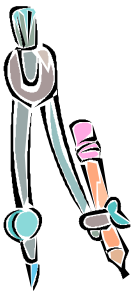
Construct each of the following geometric shapes (racetracks) using the given specifications on the grid paper (student activity booklet page 4.) Be certain to label each shape with its name as well as its measurements. When you have finished constructing and labeling all three shapes, use the scoring tool on student activity booklet page 5 to evaluate your work.

Construct the following:

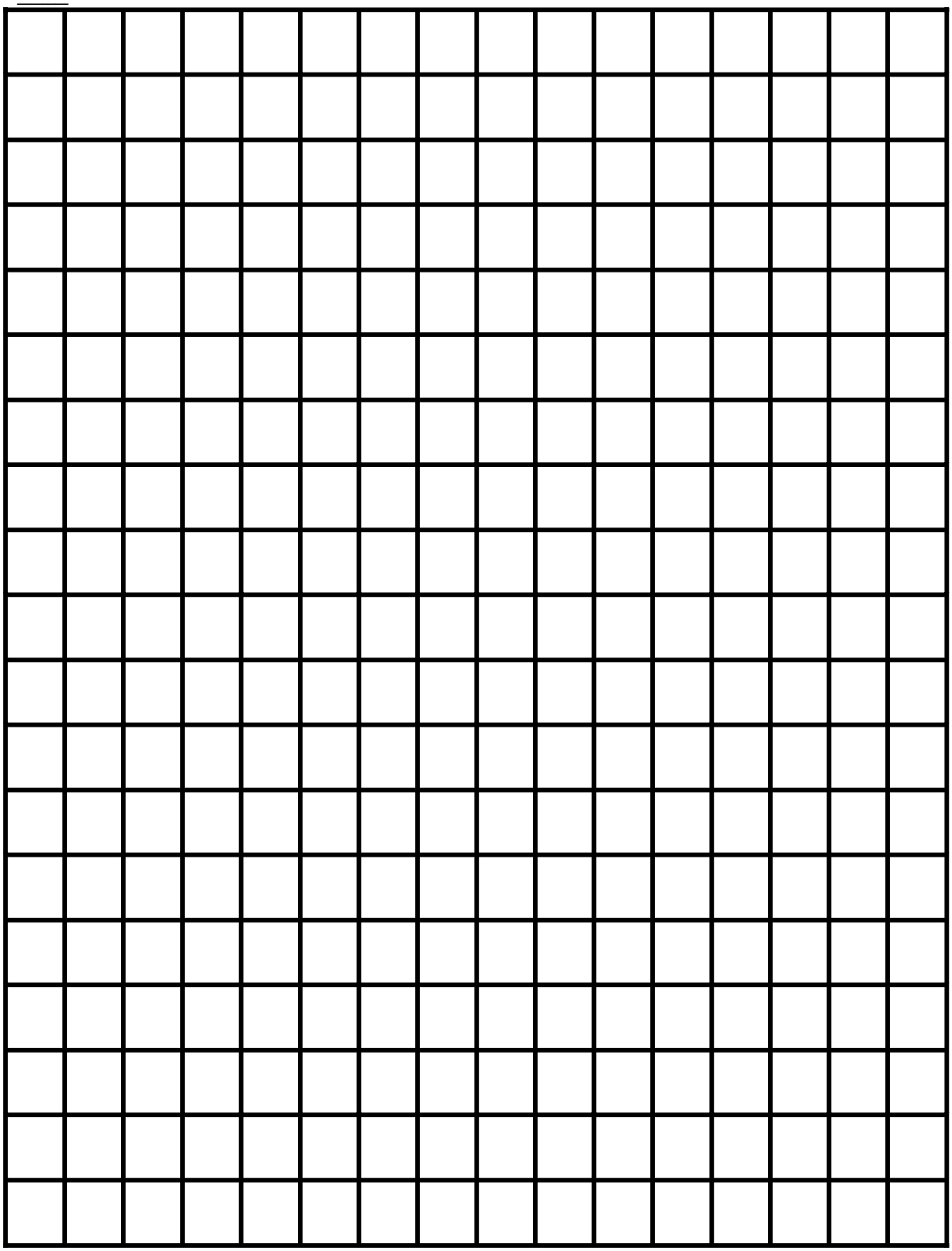
1. A geometric shape with two pairs of equal sides, four right angles, and a perimeter of 32 cm.

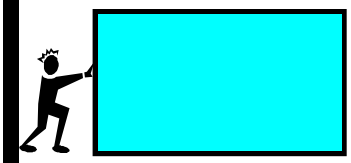
2. A geometric shape that has one side that is 6 ½ cm, another side which is 10 cm, and the last side not equal to either of the other two sides.

3. A geometric shape with a diameter of 8 cm.



Student Activity Booklet page 4

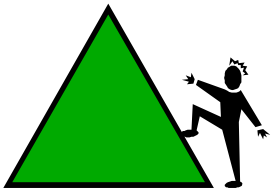




Student Activity Booklet page 5

Scoring Rubric for Constructing Rectangle

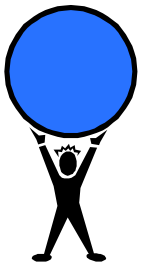
	Self	Peer	Teacher
2 . Titled Shape . Labeled sides Accurately . Attributes . Measurements			
1 Accurate . Attributes . Measurements . Title ***or*** labels may be missing			
0 Inaccurate Attributes or Measurements			



Student Activity Booklet page 6

Scoring Rubric for Constructing Triangle

	Self	Peer	Teacher
2 . Titled Shape . Labeled sides Accurately . Attributes . Measurements			
1 Accurate . Attributes . Measurements . Title ***or*** labels may be missing			
0 Inaccurate Attributes or Measurements			

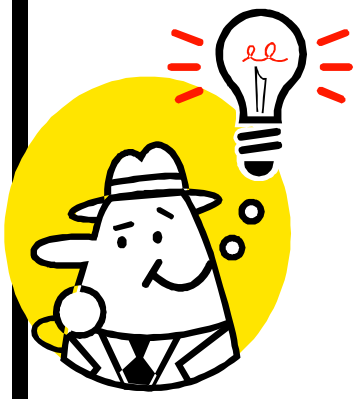


Student Activity Booklet page 7

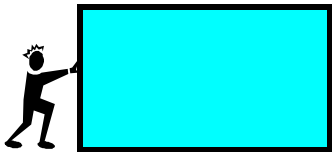
Scoring Rubric for Constructing Circle

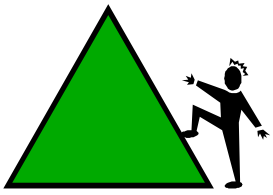
	Self	Peer	Teacher
2 . Titled Shape . Labeled sides Accurately . Attributes . Measurements			
1 Accurate . Attributes . Measurements . Title ***or*** labels may be missing			
0 Inaccurate Attributes or Measurements			

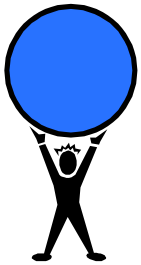
Student Activity Booklet page 8



Think about the variables we discussed that affect the design of the racetrack. Which racetrack do you think would be the best design on which to race a scooter? Support your choice with mathematical reasoning.

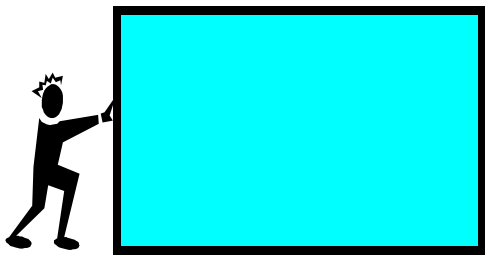






Student Activity Booklet Page 9

Now, that you have decided the design of the racetrack, you need to compute the cost of building it. The first thing that you need to do is calculate the area and perimeter of each of the three design shapes that you constructed on page 4.

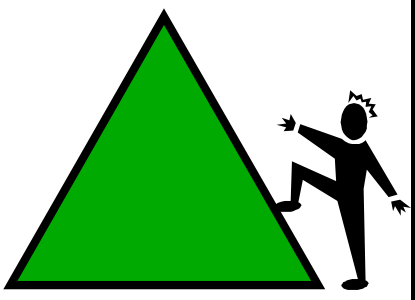


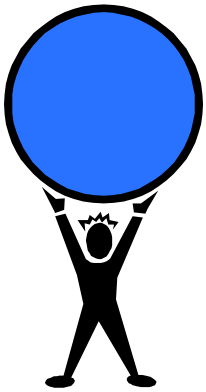
Area_____

Perimeter_____

Area_____

Perimeter_____





Area_____

Perimeter_____

Student Activity Booklet Page 10

Now, that you have determined which design you will use, calculate the cost of building the scooter racetrack.

Asphalt cost $ 4.47 per square cm.
Turf cost $ 3.27 per square cm.
Concrete cost $1.48 per square cm.

Surface Material	Area	Price Per Square cm	Total Cost
Asphalt 			
Turf 			
Concrete 			

Show your work!

Student Activity Booklet Page 11

Metal Fencing cost $2.36 per cm.
Wood Fencing cost $ 4.83 per cm.
Vinyl Fencing cost $5.99 per cm.

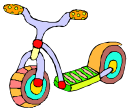
Fencing Material	Perimeter	Price Per Cm	Total Cost
Metal 			
Wood 			
Vinyl 			

Show your work

Student Activity Booklet Page 12

Which material would you choose to construct the surface of the racetrack? What type of fencing would you recommend? Use mathematical reasoning to support your choices.

Student Activity Booklet Page 13

Scooter Helmet	Quantity	Cost	Total
A 		$129.99	
B 		$79.50	
C 		$43.79	
Brain Protector 		$38.75	
Basic Helmet 		$15.64	
		Total	

Student Activity Booklet Page 14

Quick Write

Write a letter to the PTA describing the scooter racetrack that you have designed. Remember to include the materials you chose (surface of track, fencing) and equipment (scooters, helmets) as well as the cost. Use mathematical reasoning to support your choices.

Topic_____
Audience_____
Purpose_____
Form_____

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Teacher Resource Sheet # 1

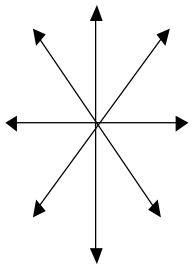
1. Use masking tape and a meter stick to construct the rectangle and triangle.

- The recommended dimensions of the rectangle are 3m by 2m. Construct the rectangle by measuring 1-meter length of tape at a time and tape it along the floor next to the meter stick. Repeat this until the rectangle is complete.

- The recommended triangle dimensions are 2m by 3m by 1m. Construct the triangle by measuring 1-meter length of tape at a time and tape it along the floor next to the meter stick. Repeat this until the triangle is complete.

2. You will use a meter stick, string, and masking tape to construct the circle.

- The recommended diameter of the circle is 2m. First, lay a meter stick on the floor. Measure and tape 1 meter of tape on the floor along side of the meter stick. Mark one end of the first piece of tape to serve as the center point. Then, repeat 1 meter of tape measurements from the center point until there are at least 6 radii. Lastly, use the string to create the circle by securing the string under the ends of the tape.



Teacher Resource Sheet # 2

Short Response Rubric

	Score	Comments
2 Clear Choice Minimum of 2 supporting details		
1 Clear Choice Minimum of 1 supporting detail		
0 Clear Choice No Supporting details		

Teacher Resource Sheet # 3

Rubric for Written Proposal Letter to PTA

	Score	Teacher Comments
3 Includes: . Design of Track . Cost of materials and equipment . At least three mathematical supports.		
2 Includes: . Design of Track . Cost of materials and equipment . Less than 3 mathematical support		
1 Includes: . Choices with little to no support		
0 Does not respond to prompt		

Teacher Resource Sheet # 4

Score Collection Sheet for all Scooter Race Activities

Assignment	Total Points Possible	Points Earned
TPWS	1	
Constructions		
Rectangle	3	
Triangle	3	
Circle	3	
Short Answers		
Designs	2	
Surface Area & Fencing	2	
Area & Perimeter		
Rectangle	2	
Triangle	2	
Circle	2	
Costs		
Surface	3	
Fencing	3	
Equipment	5	
Quick Write Letter	3	
Total	Possible 31	